WHAT IS CLAIMED IS:

1. An adaptive resource allocation method in a multi-channel communication system, comprising:

a) allocating a number of bits to be transmitted according to a subchannel quality;

b) determining a minimum power for a total transmission rate;

c) determining a channel gain for the subchannel according to the allocated number of bits and the power; and

d) determining a modulation method for each subchannel based on the channel gain.

2. The adaptive resource allocation method of claim 1, wherein, in a), a Lagrange multiplier λ is analytically and experimentally estimated to allocate the number of bits.

3. The adaptive resource allocation method of claim 1, further comprising:

in d),

adaptively performing a convex search in the recursive manner according to the average power and transmission rate; and

determining a final modulation method of the subchannels based on the searched convex.

4. The adaptive resource allocation method of claim 3, wherein a relation between the average power and the transmission rate is

represented as $P(R)=\sigma^2\alpha^{-R}$ and R>0 with reference to a given channel response and a modulator, where P(R) denotes an average power-transmission rate function, σ^2 denotes a variance of radio wave signals, and α is greater than 1.

5. The adaptive resource allocation method of claim 3, wherein the convex search process for searching an optimal solution λ^* for the given transmission rate R_t comprises:

a) respectively initializing a supremum λ_l and an infimum λ_u of the object transmission rate to be 0 and ∞;

b) experimentally selecting an initial Lagrange multiplier estimate of λ for the object transmission rate R_t;

c) solving a transmission rate non-constraint problem until a Lagrange multiplier λ corresponding to the object transmission rate R_t is found;

d) searching for a lowest transmission rate R_l and a highest transmission rate R_h; and

e) returning to solving the transmission rate non-constraint problem.

6. The adaptive resource allocation method of claim 5, wherein the initial Lagrange Multiplier value of λ satisfies $\lambda = -\frac{\partial P(R)}{\partial R} = \alpha^{-R}\sigma^2 \ln \alpha$.

7. The adaptive resource allocation method of claim 6, wherein the supremum λ_l for the object transmission rate R_t satisfies

$\lambda_l = \alpha^{-R(\lambda_l)}\sigma^2 \ln\alpha$, the infimum λ_u satisfies $\lambda_u = \alpha^{-R(\lambda_u)}\sigma^2 \ln\alpha$, and the supremum λ_l and the infimum λ_u satisfies $\frac{\lambda_u}{\lambda_l} = \alpha^{R(\lambda_u)-R(\lambda_l)}$

8. The adaptive resource allocation method of claim 7, wherein an optimal λ^* corresponding to the object transmission rate R_t satisfies $\lambda^*(R_t) = \alpha^{-R_t}\sigma^2 \ln\alpha = \lambda_l \alpha^{R(\lambda_l)-R_t}\sigma^2 \ln\alpha = \lambda_l \left(\frac{\lambda_u}{\lambda_l}\right)^{\left(\frac{R(\lambda_l)-R_t}{R(\lambda_l)-R(\lambda_u)}\right)}$

9. The adaptive resource allocation method of claim 7, wherein the optimal λ^* corresponding to the object transmission rate R_t satisfies $\lambda^*(R_t) = \lambda_u \left(\frac{\lambda_l}{\lambda_u}\right)^{\left(\frac{R_t-R(\lambda_u)}{R(\lambda_l)-R(\lambda_u)}\right)}$.

10. The adaptive resource allocation method of claim 5, wherein, in c) for solving the transmission rate non-constraint problem, a less Lagrange multiplier λ is selected for the purpose of having a solution representing a higher transmission rate in a next step when a transmission rate for a predetermined solution or a highest transmission rate for a plurality of solutions is less than the object transmission rate R_t, which is repeatedly performed until the Lagrange multiplier λ corresponding to the object transmission rate R_t is found.

11. The adaptive resource allocation method of claim 10, wherein, in c) for solving the transmission rate non-constraint problem, a lowest

transmission rate R_t and a highest transmission rate R_h are found when the initial estimate λ is a singular value.

12. The adaptive resource allocation method of claim 10, wherein, in c) for solving the transmission rate non-constraint problem, one transmission rate satisfying a relation of $R_l=R_h=R(\lambda)$ is found when the initial estimate λ is not a singular value.

13. The adaptive resource allocation method of claim 10, wherein, in d) for searching for the lowest transmission rate R_l and the highest transmission rate R_h, the initial estimate λ becomes the optimal value when a relation of $R_l \leq R_t \leq R_h$ (lowest transmission rate ≤ object transmission rate ≤ highest transmission rate) is given.

14. The adaptive resource allocation method of claim 10, wherein, in d) for searching for the lowest transmission rate R_l and the highest transmission rate R_h, a transmission rate $R_H(>R_h)$ in which a power reduction rate is maximized compared to the transmission rate increase at R_h and the supremum λ_u is updated with an inclination between R_h and R_H when a relation of $R_h<R_t$ (highest transmission rate < object transmission rate) is given.

15. The adaptive resource allocation method of claim 14, wherein the transmission rate R_H in which the power reduction rate is maximized is found by searching for available modulation methods having transmission rates greater than R_h.

16. The adaptive resource allocation method of claim 15, wherein the initial Lagrange multiplier estimate λ becomes the optimal solution when a relation of $R_h \le R_t \le R_H$ (highest transmission rate ≤ object transmission rate ≤ transmission rate in which the power reduction rate is maximized) is given.

17. The adaptive resource allocation method of claim 16, wherein the initial Lagrange multiplier estimate λ for a next process is estimated in an experimental manner when the infimum is 0, and the estimate Lagrange multiplier λ for a next process is calculated by the equation 14 or 15 when the infimum is not 0.

18. The adaptive resource allocation method of claim 10, wherein, in d) for searching for the lowest transmission rate R_l and the highest transmission rate R_h, the transmission rate $R_L(<R_l)$ in which the power reduction rate is maximized compared to the transmission rate increase at the lowest transmission rate R_l is found and the supremum λ_l is updated with an inclination between R_l and R_L when a relation of $R_l>R_t$ (lowest transmission rate > object transmission rate) is given.

19. The adaptive resource allocation method of claim 18, wherein the transmission rate R_L in which the power reduction is maximized is found by searching for available modulation methods having transmission rates less than R_l.

20. The adaptive resource allocation method of claim 19, wherein

an initial Lagrange multiplier estimate λ becomes the optimal value when a relation of $R_L \leq R_t \leq R_l$ (transmission rate in which power reduction rate is maximized ≤ object transmission rate ≤ lowest transmission rate) is given.

21. The adaptive resource allocation method of claim 20, wherein the initial Lagrange multiplier estimate λ for a next process is estimated in an experimental way when the supremum λ_u is ∞, and the estimate Lagrange multiplier λ for a next process is calculated by the equation 14 or 15 when the supremum is not ∞.

22. An adaptive resource allocation processor in an orthogonal frequency division multiplexing system comprising:

a channel estimator for estimating a channel quality;

an adaptive subchannel allocator for determining a channel gain for a subchannel based on the estimated channel value, and allocating bits and power for the subchannel based on the channel gain; and

an adaptive bit loader for outputting a bit table and a power table according to the allocated bits and power.

23. The adaptive resource allocation processor of claim 22, further comprising a symbol mapper and a symbol demapper for respectively mapping and demapping bits and power of symbols according to the bit table and the power table.